SAND2015-1556C

INCORPORATING WORKFLOW FOR V&V/UQ IN THE SANDIA ANALYSIS WORKBENCH

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SOS-19

Park City, UT

March 2-5, 2015

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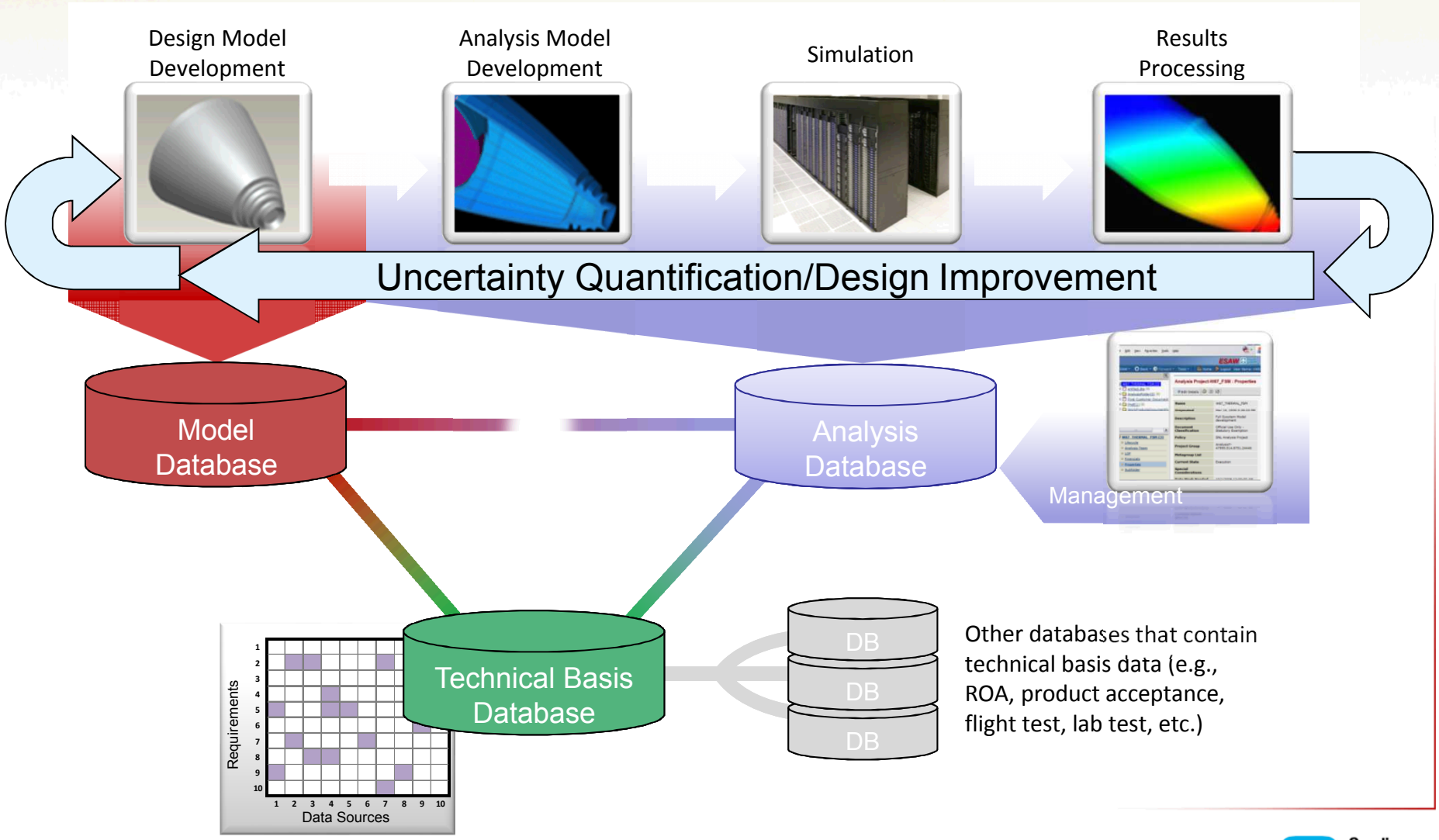
Support the Design-To-Analysis process, capturing data in context



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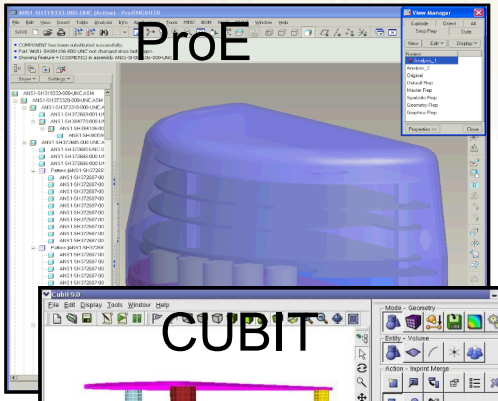
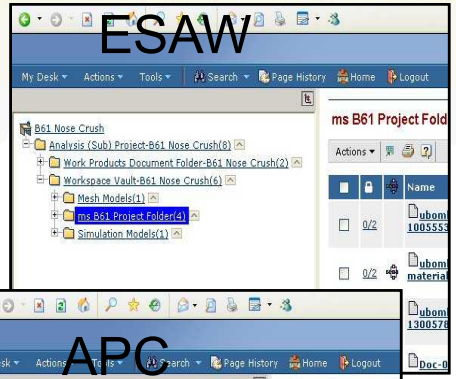
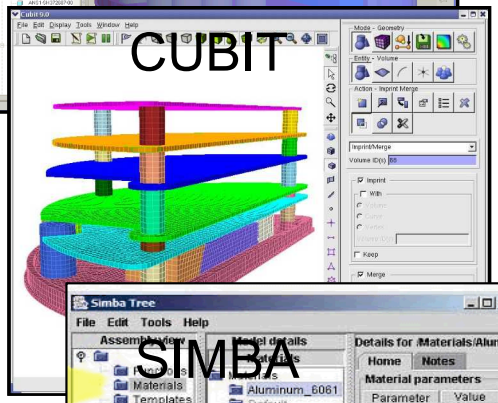
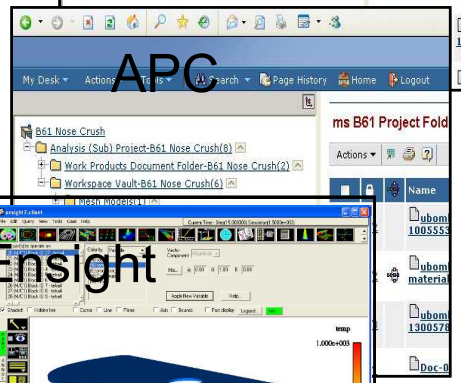
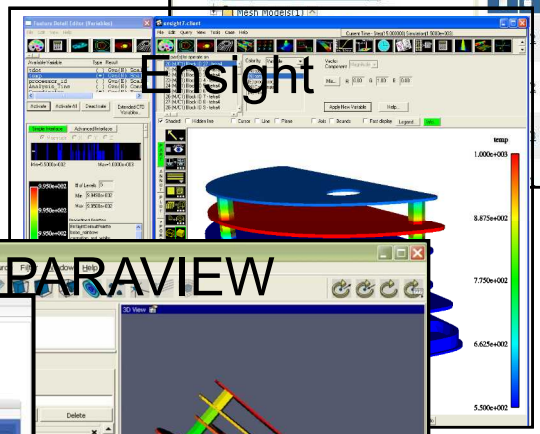
Pre-2010 – Federated Toolkit for Design through Analysis

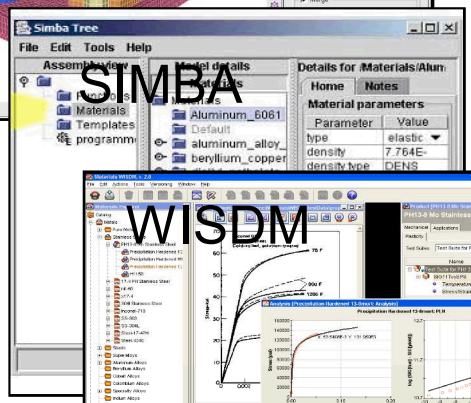


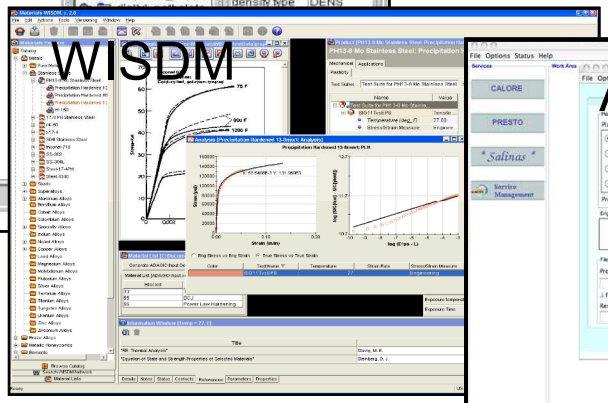


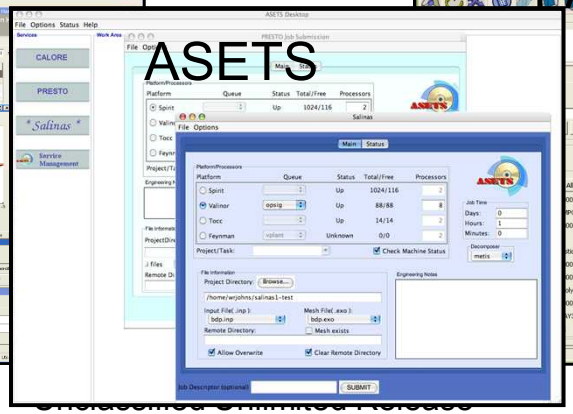


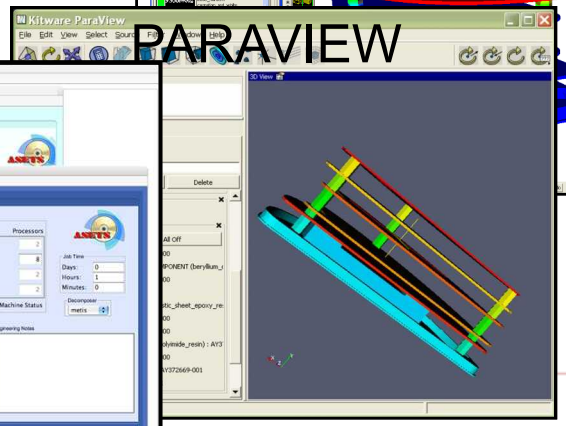












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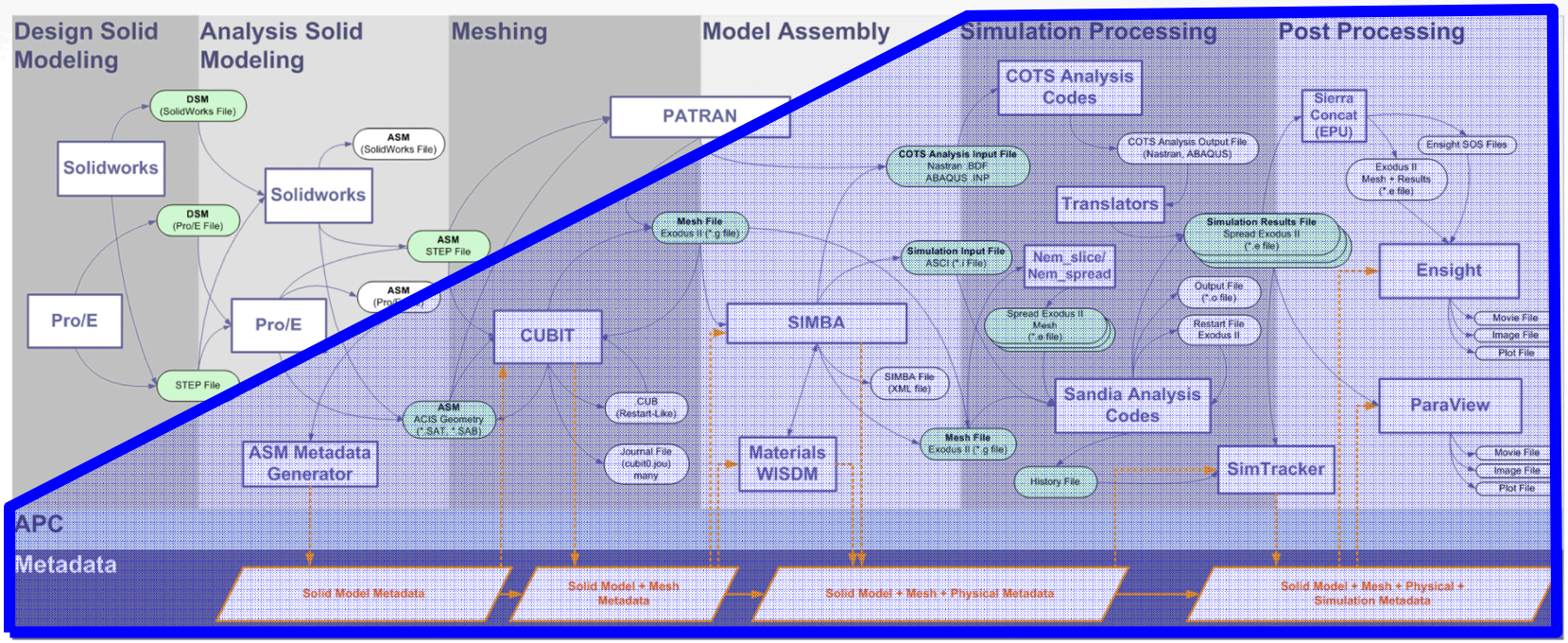

Sandia Analysis Workbench

- The analysis process involves many (stove-piped) tools that generate a large number of artifacts, which must be managed by the analyst.
- Vision: an integrated environment for these tools

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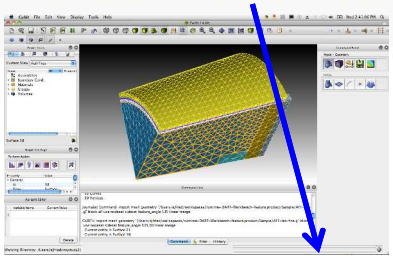
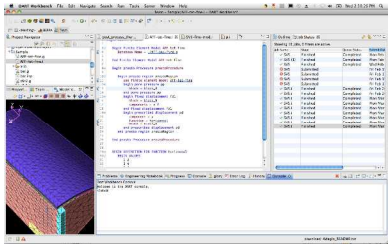
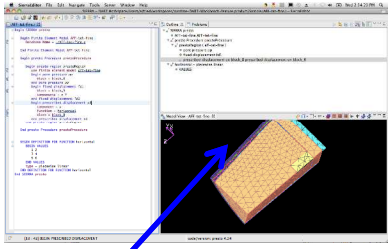
SAW provides a unified view of distributed enterprise resources on the desktop

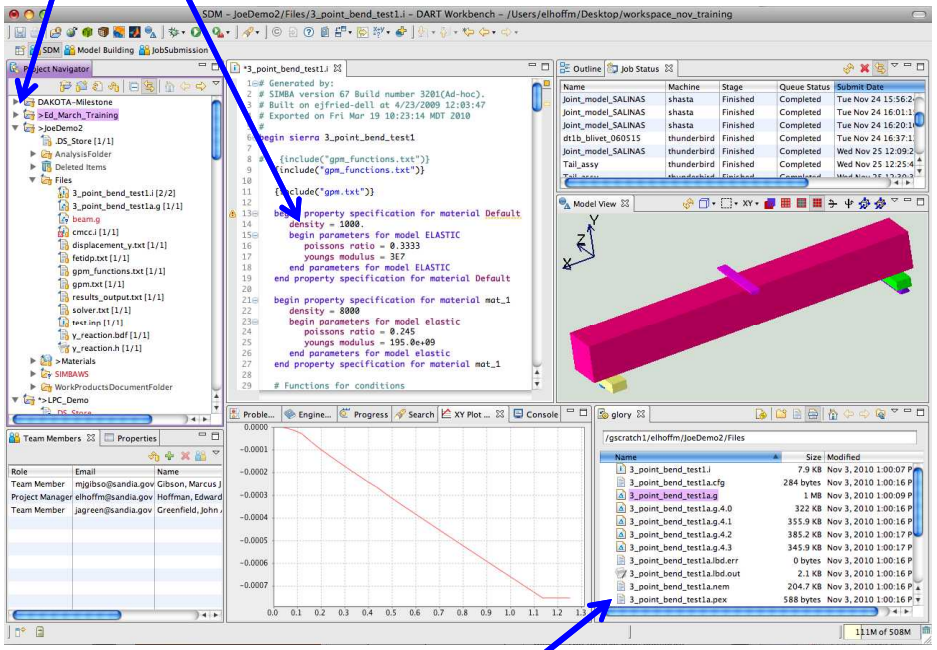
Simulation Data Management Model Assembly Job Management







Multiple applications and tools combined into one, streamlining work and drastically reducing complexity



Teaming

Distributed File Management & Viz

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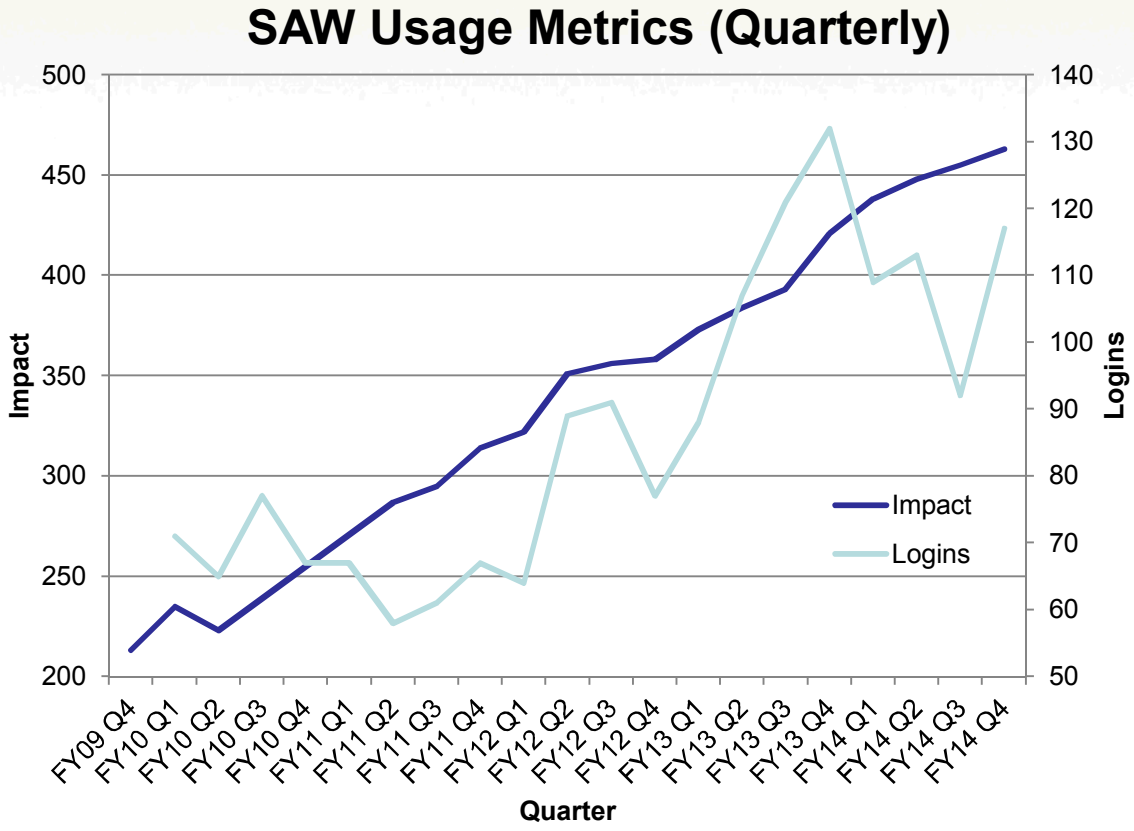
Metrics show widespread adoption of SAW



"Impact" represents staff who own data in our repositories
"Logins" are unique users of our data management service

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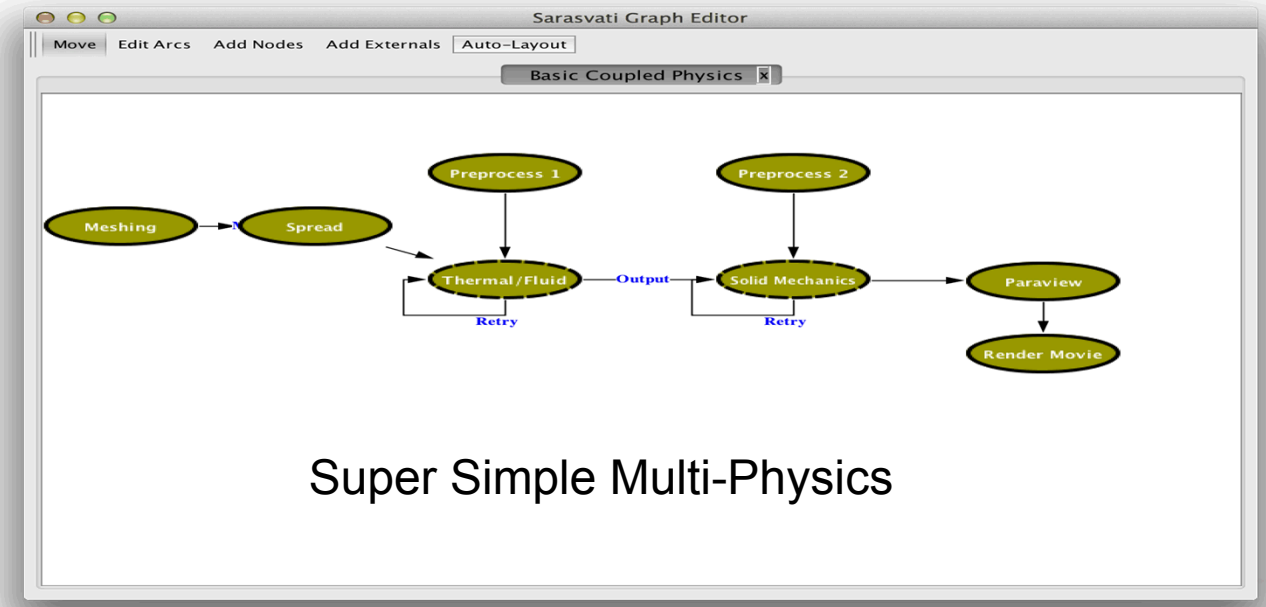
Automating workflow is a natural extension

- Workflow: a graph of connected nodes
  - Nodes represent activities
  - Arcs represent transitions, and may specify data interchange
  - There is a start and end node, and the start node may have preconditions



Super Simple Multi-Physics

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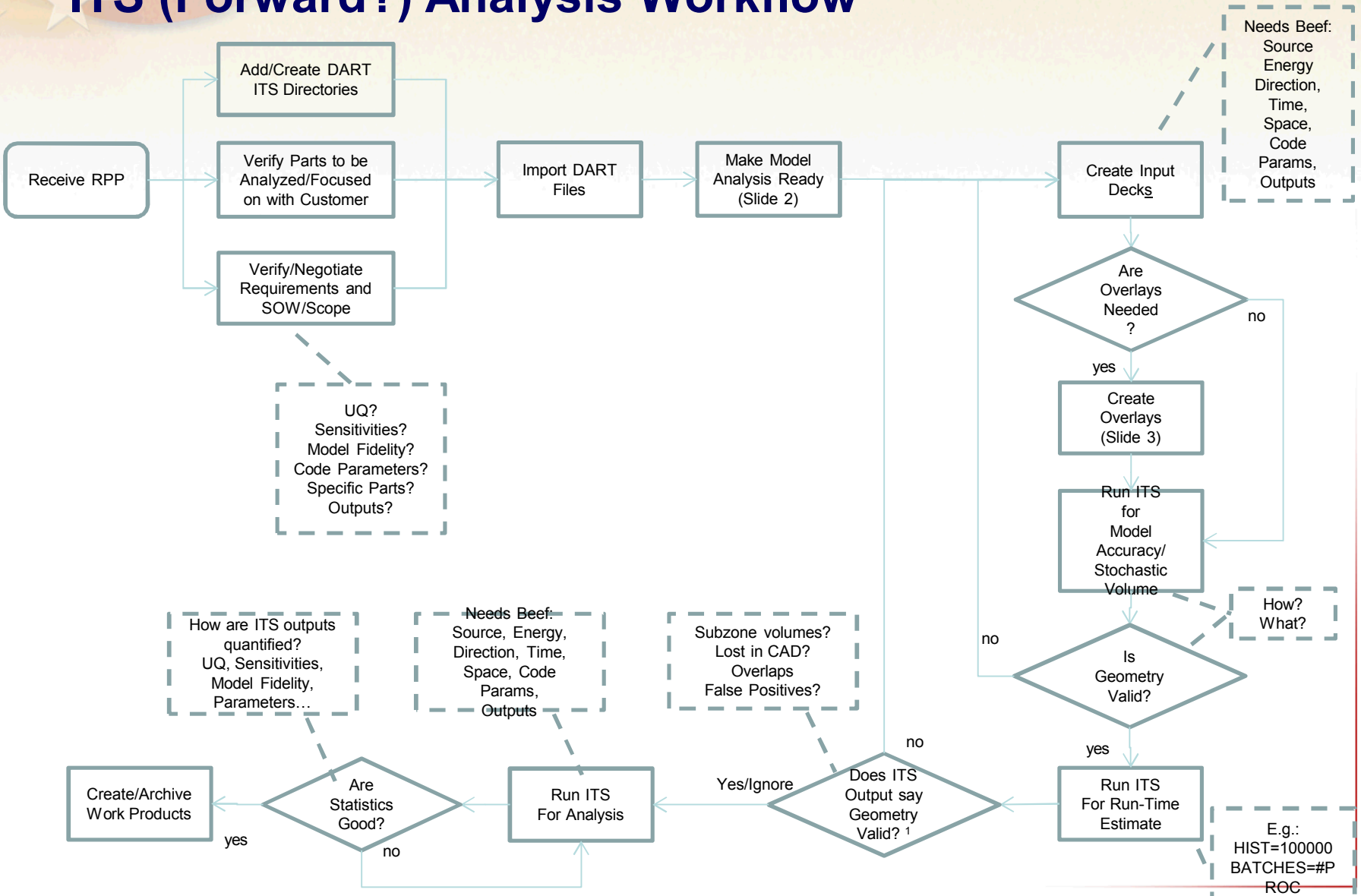
ITS (Forward?) Analysis Workflow



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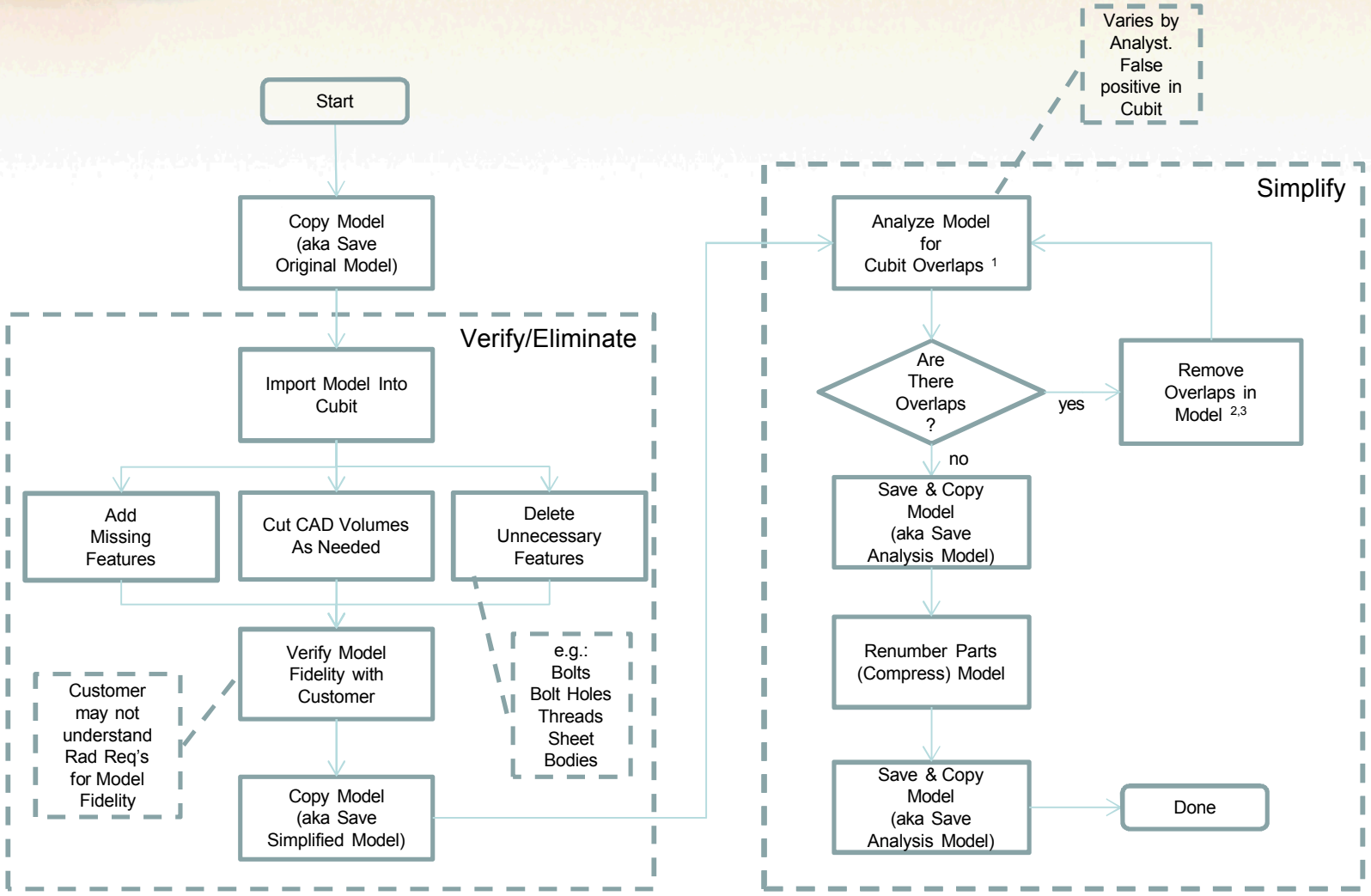
Make Model Analysis Ready – Eliminate, Simplify



[1] Cubit: Power Tools -> Geometry -> Analyze
[2] Cubit: Command Panel -> Boolean -> Subtract [keep] A (outer) from B (inner); Delete B
[3] May require part to be split into 2 volumes

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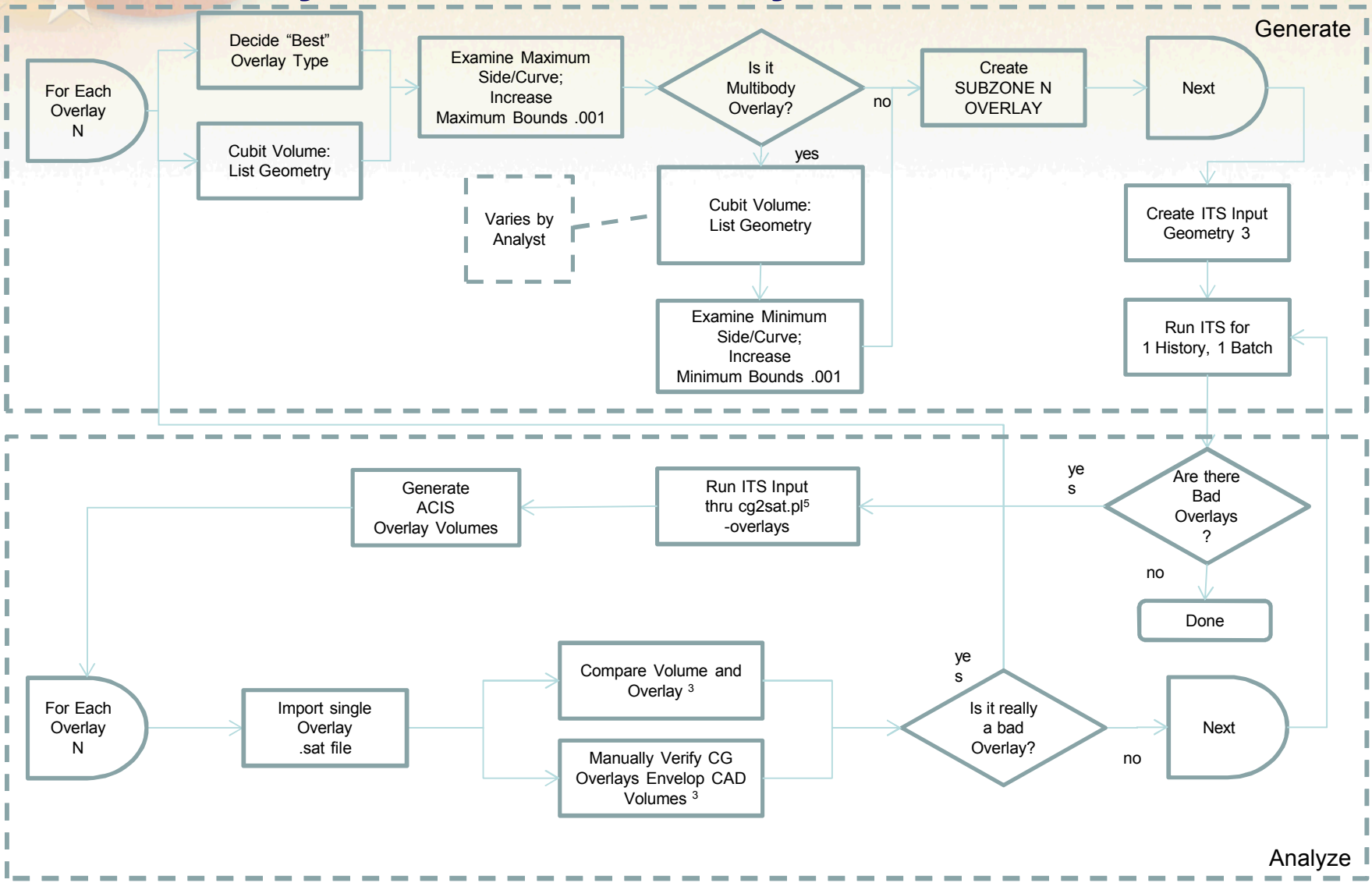
Create/Analyze Subzone Overlays



[3] Cubit: Command Panel -> Boolean -> Subtract (keep) Overlay from Body; Check for Overlay encloses Volume

[4] Run outofrange.pl output; check for too many counts for a given volume

[5] New cg2sat feature

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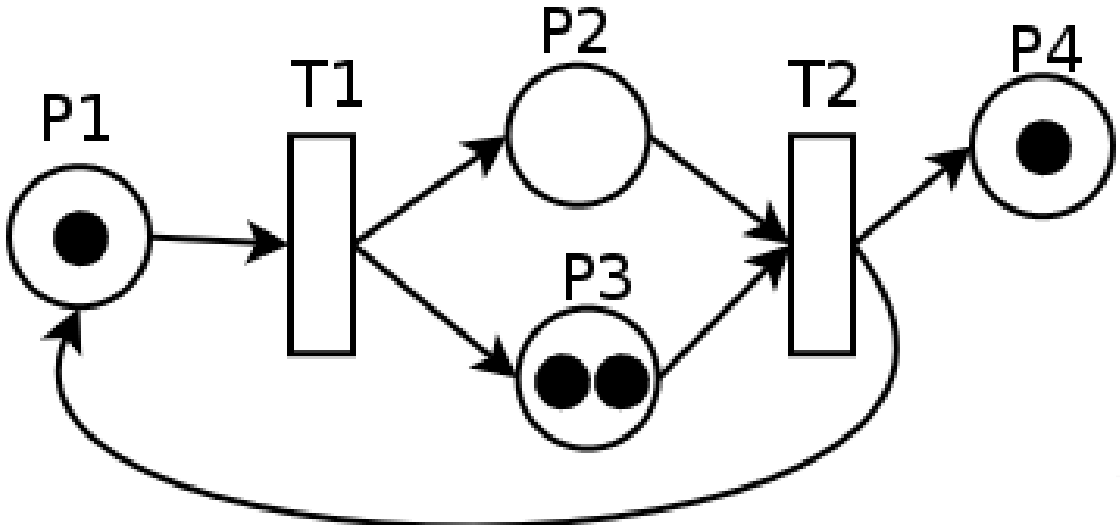
V&V of workflows adds complexity

- Complicated workflows are difficult to formally understand (and may exhibit complexity)
  - V&V'd components don't add up to V&V'd workflows
  - Provable workflows are an important aspect of V&V
  - Workflows may be converted to Petri Nets and formally proven



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Workflow execution characteristics

- Creates an auditable document trail
  - It is possible to data-mine workflows to ensure compliance as well as to identify opportunities for process improvement
  - Outputs may be captured and traceably related
- Re-execute at any time
  - Increased speed and reliability
  - Parametric analysis relatively straightforward
  - Perform V&V sub-tasks when a prerequisite changes
- May become sub-workflows
  - Embed complexity
  - Sharable workflow elements (e.g., meshing workflow)

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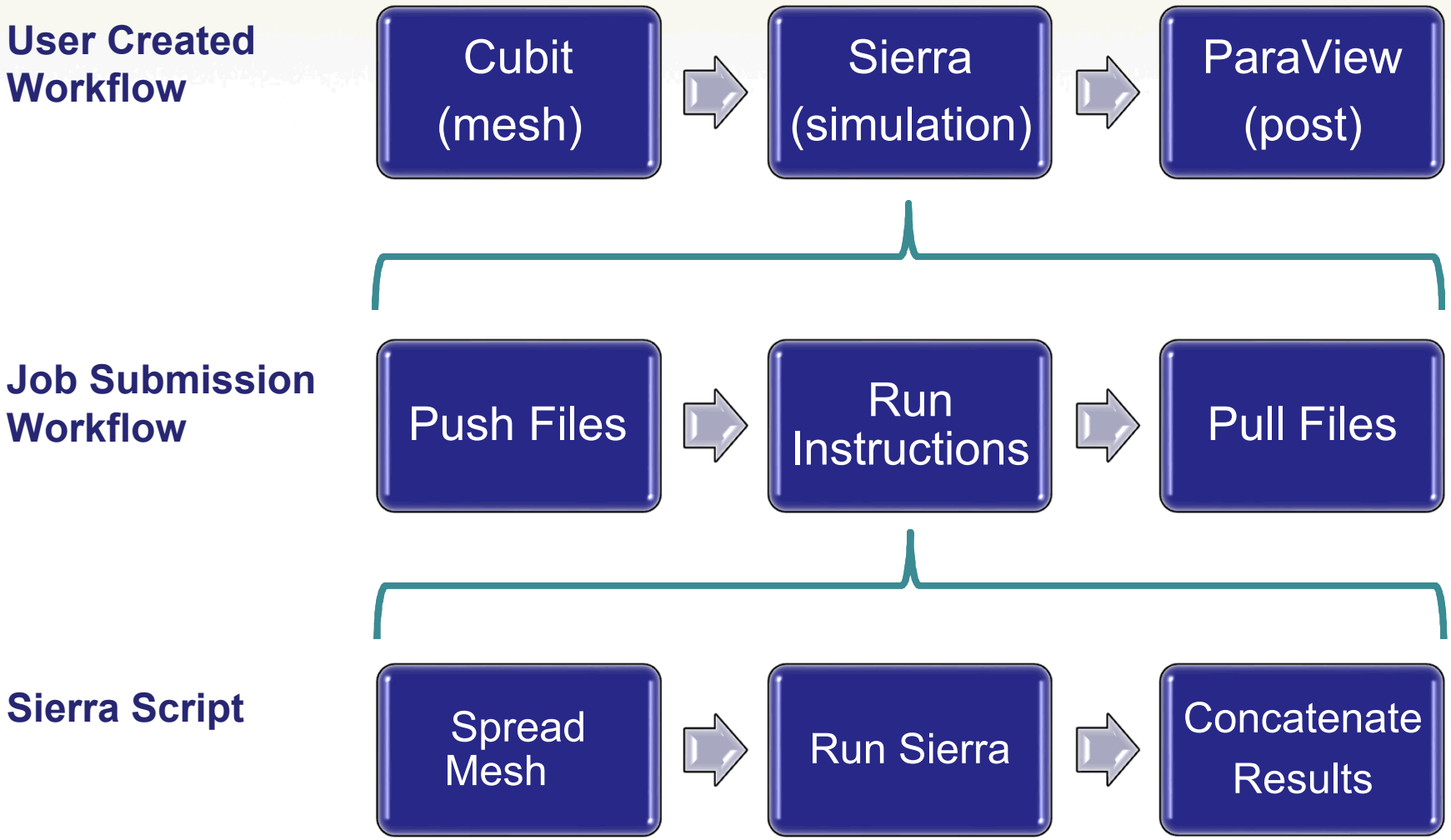
Nested Workflows – Workflows reused in other workflows



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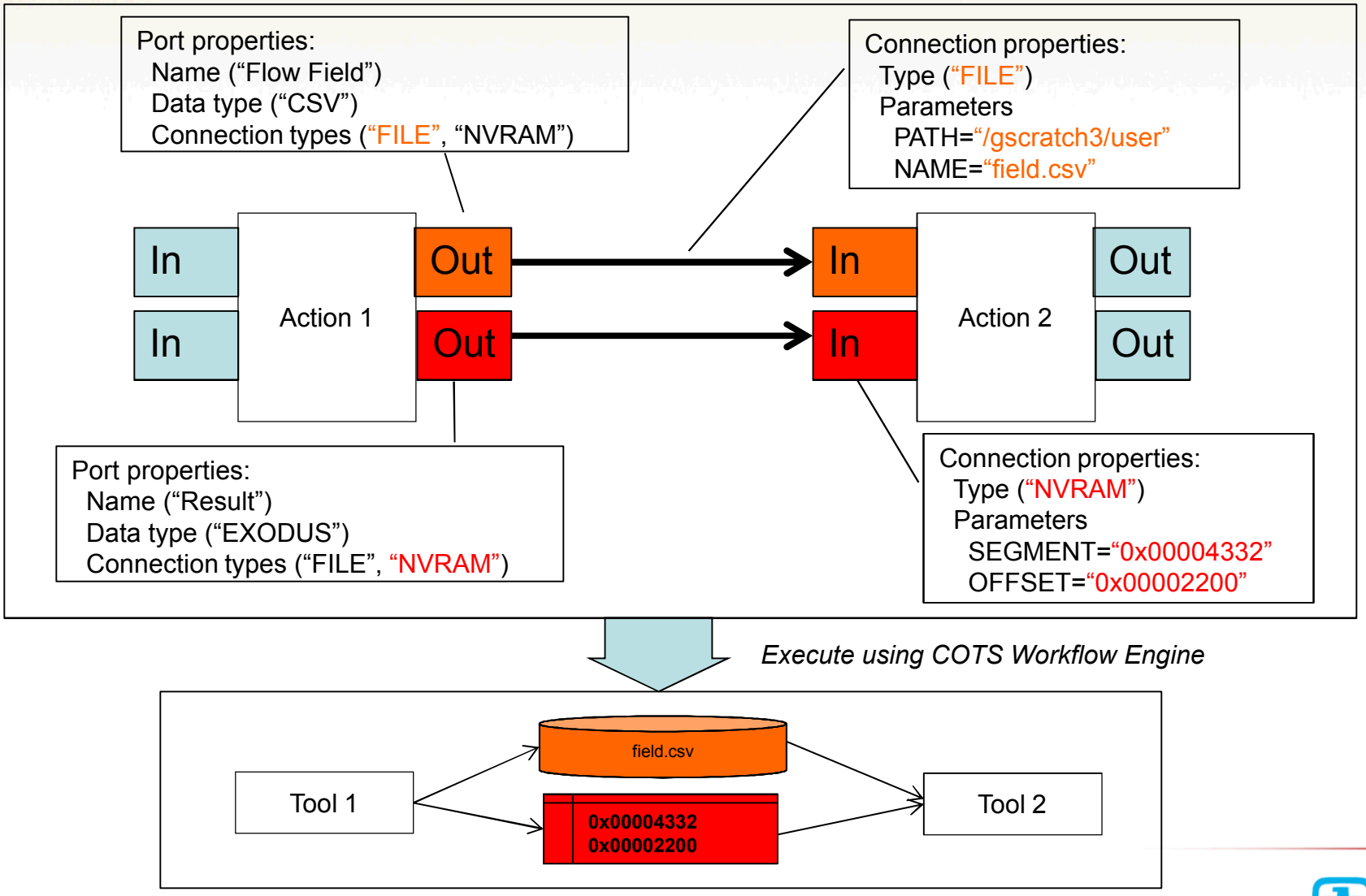
Proposed scalable workflow architecture directly connects HPC codes using available Comms



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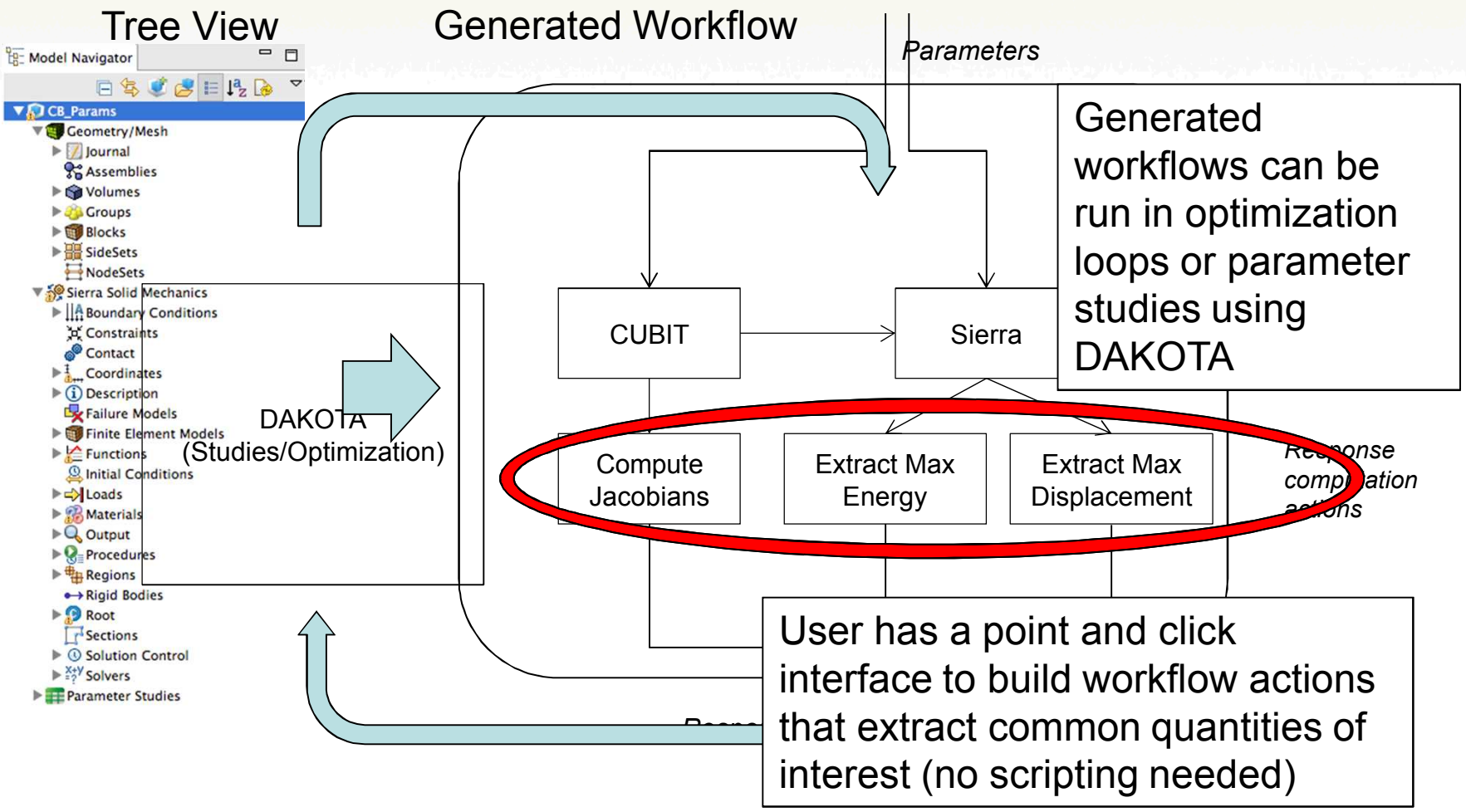
Current Status: Automatic Workflow Generation



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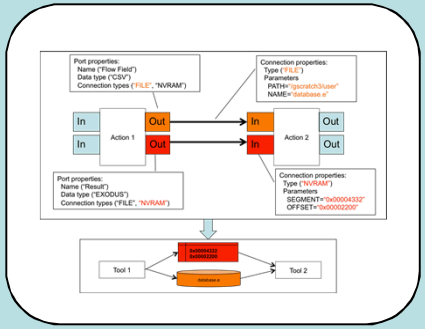
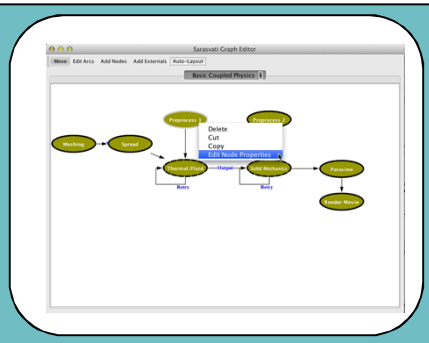
Implementing a Complete Workflow Capability

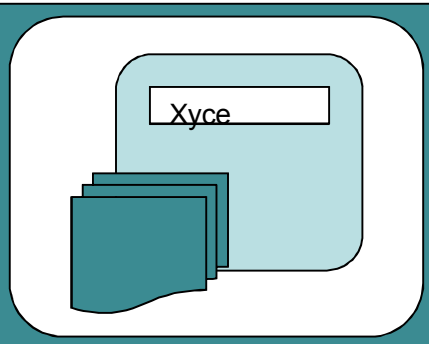
Finish full architecture implementation



Add graphical workflow editor and visualizer



Add generic configurable workflow action for user codes



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Research Issues – Starter List

- Scalable workflow architecture (data flow, staged execution of processes, …)
- Building and managing workflows
- Workflow resilience
- Workflow V&V
- Sharing components and workflows

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Acknowledgements

- Ernest Friedman-Hill (PI)
- Ed Hoffman
- Marcus Gibson
- Kevin Olson
- Mike Glass (Sierra)
- George Orient (V&V apps)
- Brian Adams (Dakota)